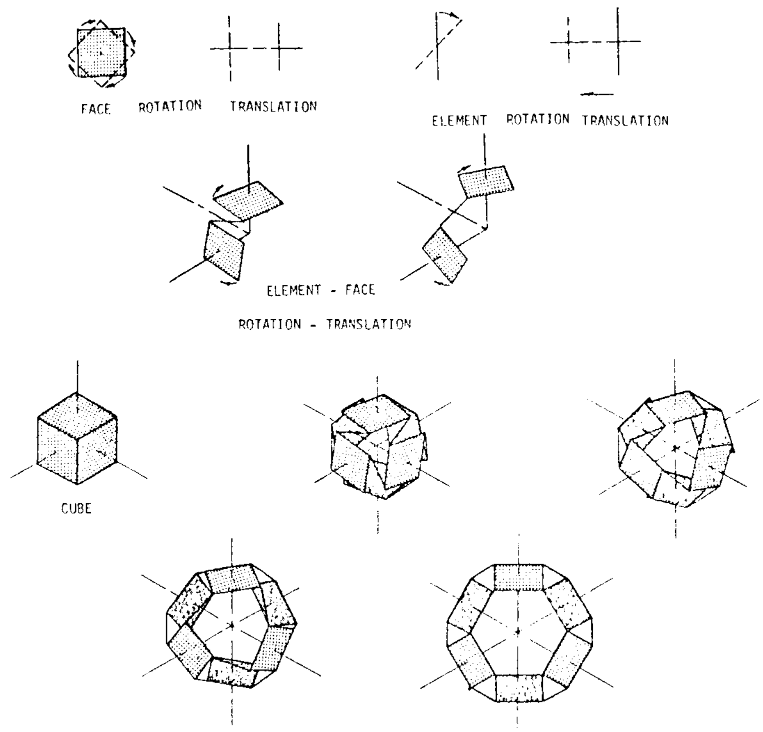
TECHNICAL BRIEF

STRUCTURAL DESIGN CONCEPTS

THE SCHOOL OF TECHNOLOGY
OF
SOUTHERN ILLINOIS UNIVERSITY

A CONCEPT OF ELEMENT-FACE ROTATION-TRANSLATION TRANSFORMATION OF POLYHEDRA



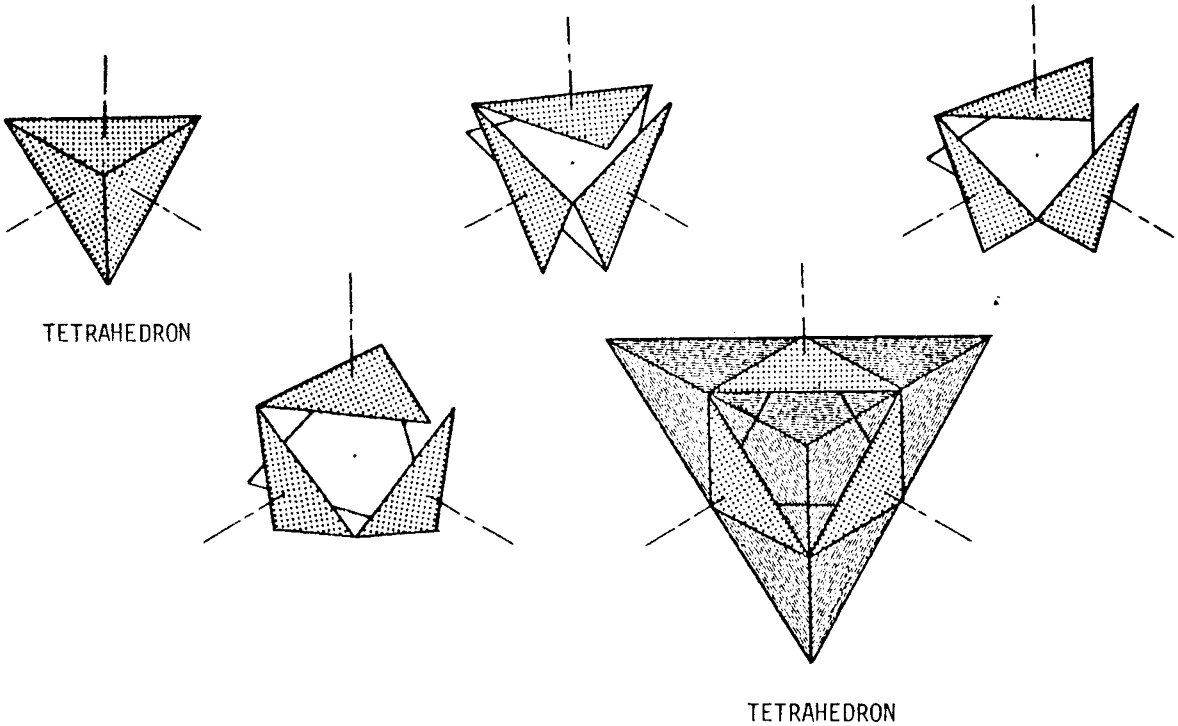
The method of transformation discussed here is accomplished by allowing each face of the polyhedron to rotate about its axis and translate along its axis, while maintaining connection to its paired face with an element that is allowed to rotate about its axis and translate along its axis. The surfaces enclosing the polyhedron will transform into another polyhedron form.

The polyhedral forms which have been investigated consist of the five regular forms. The one illustrated above shows the transformation stages of the cube to the truncated octahedron. The five transformation series studied are listed below.

tetrahedron →		→ truncated tetrahedron
cube →	snub cube →	truncated octahedron
octahedron →	snub cube →	truncated cube
icosahedron →	snub dodecahedron →	truncated dodecahedron
dodecahedron →	snub dodecahedron →	truncated icosahedron

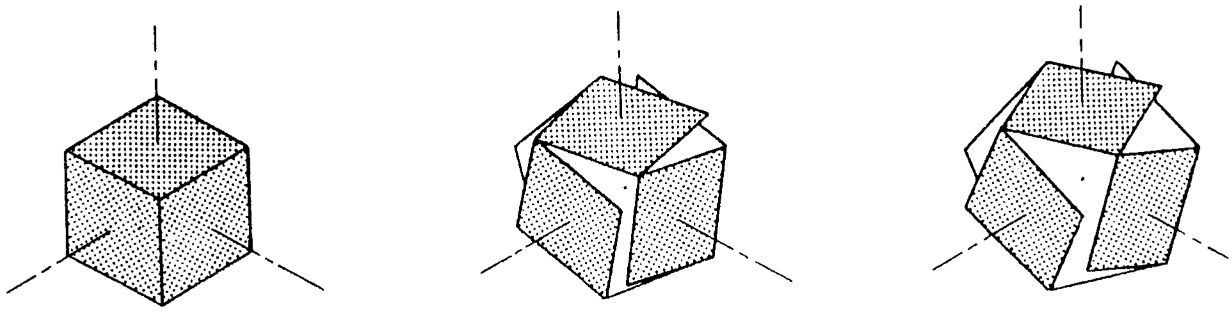
Source: Joseph D. Clinton
Southern Illinois University
School of Technology (6601-02)

A REGENERATION EFFECT

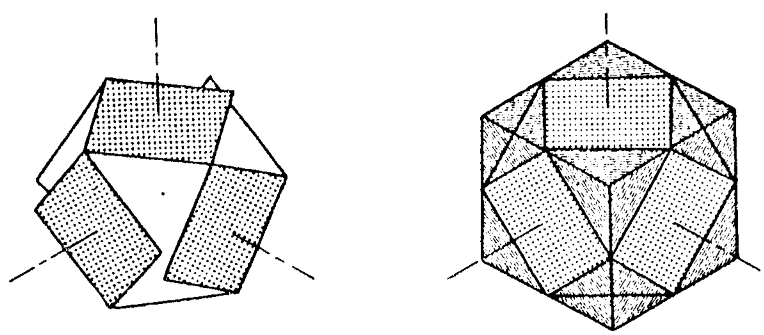


By using the traditional expandable concept of folding in conjunction with the concept of face rotation-translation transformation, a regeneration is accomplished after the transformation sequence has taken place. After the final form of the transformation has been obtained, the existing faces are rotated about their elements, thus filling the voids created during the transformation. A cycling or regeneration has thus taken place where the original form has been transformed into a new configuration and then regenerated into its original form retaining its axis of transformation; however, it has increased in surface area and volume.

The forms which have thus far been studied are the five regular polyhedra or platonic polyhedra. Three of these forms (tetrahedron, octahedron, icosahedron) are composed entirely of triangular sides and may be regenerated per previous illustration. Two of the forms (cube, dodecahedron) are composed of polygons other than triangular in shape. Because of this difference, the regeneration may be accomplished by rotating parts of the existing face about its elements, per following example:



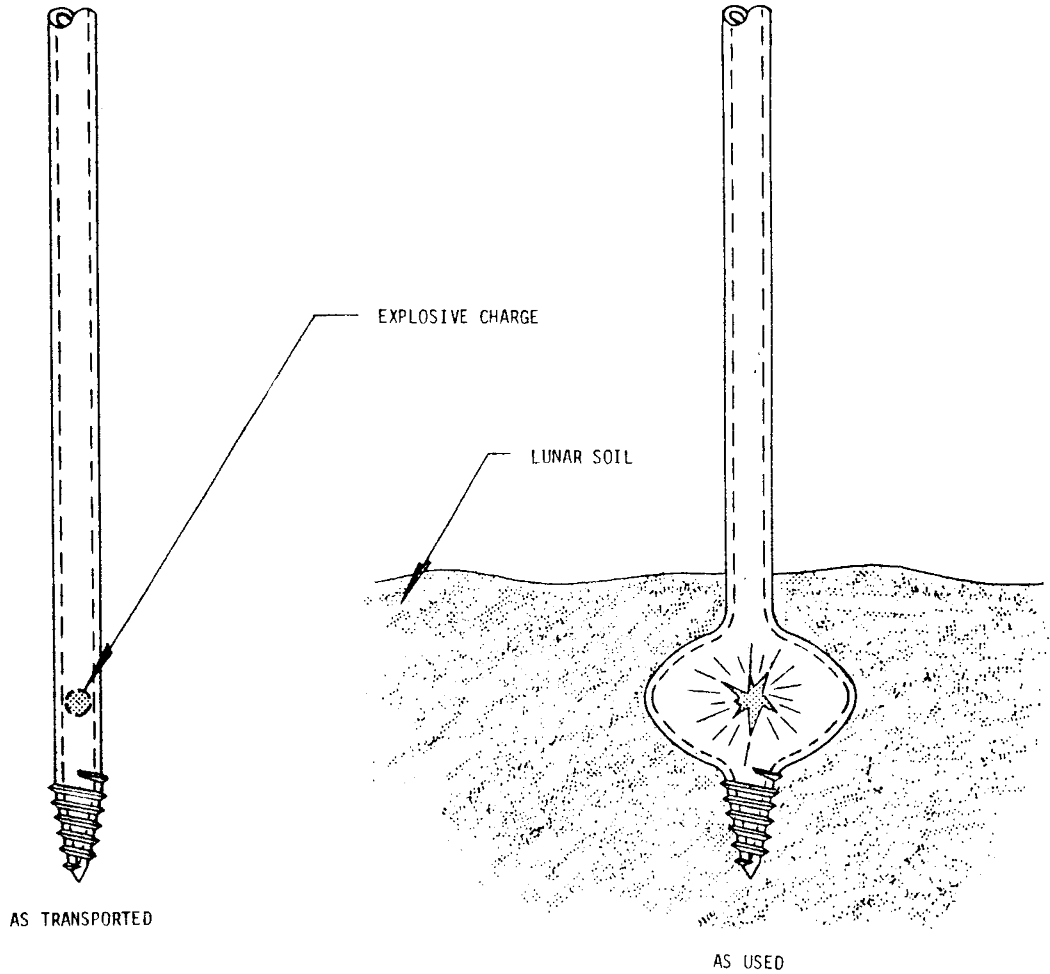
CUBE



CUBE

Source: Joseph D. Clinton
Southern Illinois University
School of Technology (6601-03)

CONCEPTS REGARDING SUB-SURFACE SUPPORTED
STRUCTURAL COLUMNS FOR LUNAR APPLICATION



The structural column shown above would be tubular in form and fabricated from a low density, ductile material. In order that it could be inserted into the lunar surface by rotation, one end would be provided with a helical configuration. An explosive charge would be enclosed within the tube. This charge would be detonated after the column had been inserted, thereby deforming the column below grade and providing additional stability. This system would be similar to the present industrial methods of high-energy-rate metal forming.

Source: Philip G. Elliott
Southern Illinois University
School of Technology (6601-01)

CONCEPTS REGARDING SUB-SURFACE SUPPORTED
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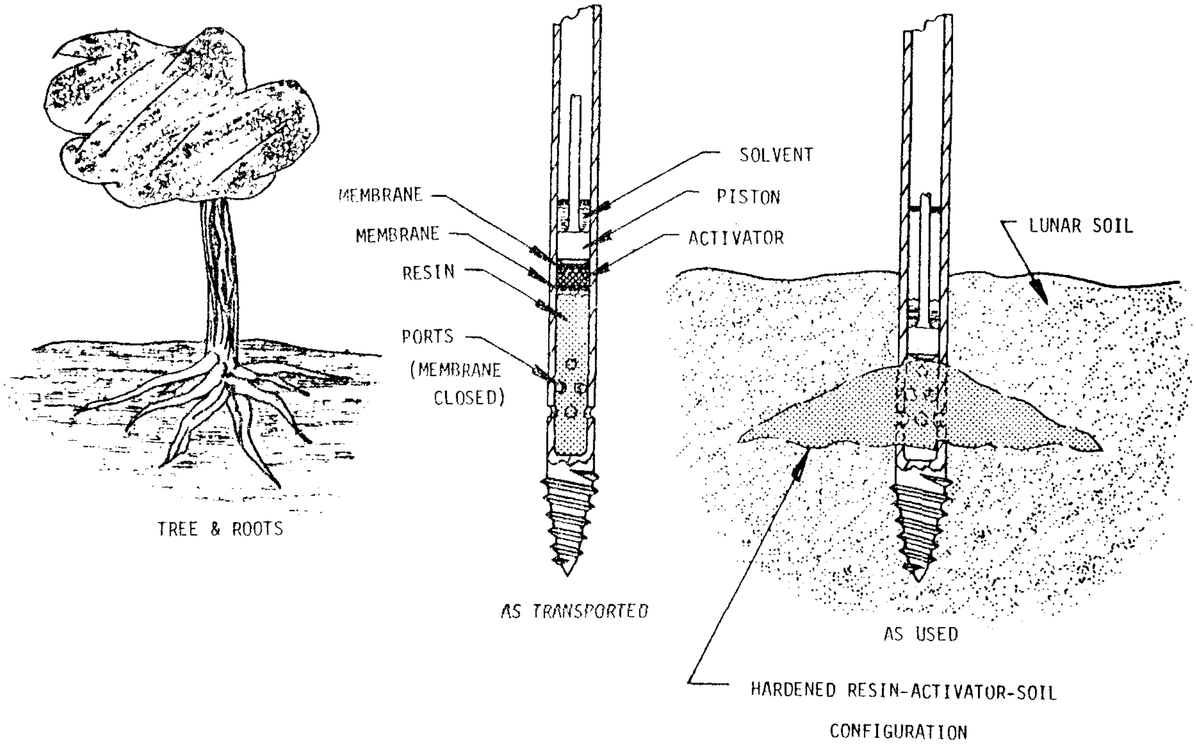
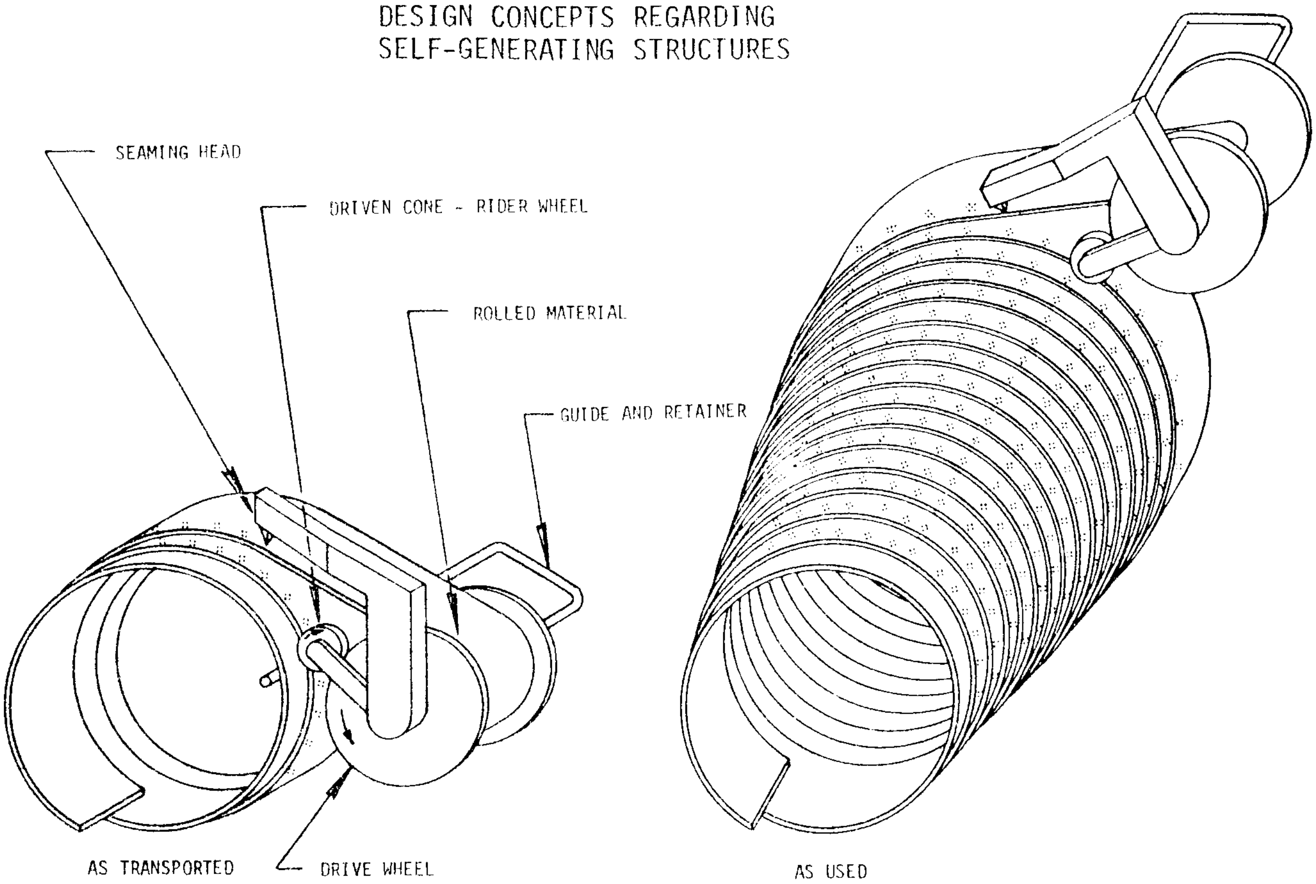


As shown above, a variation of the concept described on the preceding page can be had by drawing an analogy to the root system of a tree. As the tree grows, the main roots spread out farther and deeper, adding to the support of the tree. If "roots" could be grown on a structural column, a similar benefit could be achieved. Such a root system might be achieved by adding ports in the end of the previously described tube, filling it with a resin and activator of the polyester type, and providing a piston to force the resin-activator mixture into the soil. The soil would act as a filler for the mixture, thereby adding strength to the hardened mixture. By varying the size and location of the ports, different below-grade configurations would be possible. A solvent could be provided to allow removal of the column.

Source: Philip G. Elliott
Southern Illinois University
School of Technology (6601-02)

DESIGN CONCEPTS REGARDING SELF-GENERATING STRUCTURES

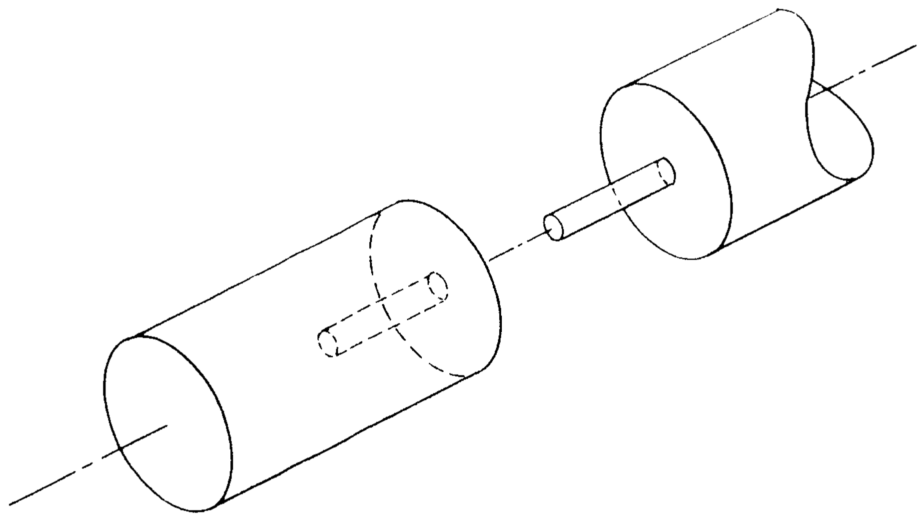


SELF-GENERATED TRUNCATED CONE

Being in the form of rolls, stacked sheets, and etcetera, structural materials are normally in their most compact form before fabrication. With this thought in mind, it is possible to make a case for space and planetary structures which are fabricated at their intended place of use. One apparent disadvantage would be that the means (machinery) of construction would have to be transported along with the material. Assuming that this disadvantage could be eliminated by technological advances, the above illustration depicts a concept in self-generating structures which would take advantage of a compact material form; the roll.

Source: Philip G. Elliott
Southern Illinois University
School of Technology (6601-03)

CONCEPTS RELATING TO THE JOINING OF STRUCTURAL MEMBERS



Several possibilities relating to the joining or connecting of structural members are herein presented for consideration by design personnel. (In this instance, one might wish to presuppose that the workers assembling the structure are working in a hostile environment and/or are working with only the simplest of tools or facilities.)

(1) Consider a male-female, journal-bearing-like, plug-in connector. (See above figure.) It is feasible that such a connection may be sufficiently strong to allow simple or multiple axial or rotative loadings. If the respective male and female diameters are nearly identical, it may not be possible to force the two into a satisfactory fit; however, if one part is rotated with respect to the second, it should be possible to readily join the two (simply and without great force) since the coefficient of friction has been reduced by the effects of rotation.

(2) An extension of concept (1), above, wherein one member is rotated quite rapidly, there being no lubricant between the two members, thereby, causing the two members to become fused together.

(3) Consider how a rusted nut on a rusted bolt normally makes an extremely strong connection. Might it be feasible to subject two structural members to some artificial atmosphere so as to produce controlled rusting to thereby mate the two pieces?

(4) Consider the manner in which the under portions of ships become fouled by the growth of marine organisms over a period of time. Such fouling often causes valves or other sea openings to become jammed. Might it be feasible to introduce such marine organisms into or near a connection between structural members, produce a suitable atmosphere for the organisms to grow or multiply, and thereby cause a rigid connection to be made?

(5) Consider structural members mated to each other in a manner similar to the principle of a go/no-go plug gage. Consider that a portion of the structure or vehicle might always be "warm" when in use, perhaps in the vicinity of a heat source or facing the sun. To initially fabricate the structure, one might turn the structure so as to shield one of the members from the heat source, then press-fit it into the other member ("go"), then, turn the connection toward the heat source once again to heat up the entire joint ("no-go"). A tight fit should persist for as long as the structure faces toward the heat source.

Source: Wayne A. Muth
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